Code No: **R1641044** **R16** **Set No. 1**

IV B.Tech I Semester Regular Examinations, October/November - 2019

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

PART–A *(14 Marks)*

1. a) Define (i) Acceptance angle (ii) Numerical aperture. [2]
   b) Explain core and cladding losses in an optical fiber. [3]
   c) Write short notes on single mode fiber joints. [2]
   d) Write short notes on reliability of LED & ILD. [3]
   e) What you meant by power coupling? [2]
   f) What are the advantages of the WDM? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Draw the electromagnetic spectrum, explain different ranges and their wavelengths. Clearly show the range of wavelengths used for optical fiber communication. [7]
   b) Define an optical fiber. Explain in detail different types of optical fibers with neat sketches. [7]

3. Write short note on the following:
   (i) Chromatic dispersion (ii) Polarization mode dispersion
   (iii)Material dispersion [14]

4. a) Discuss the different techniques to connect the 2 optical fibers with different lengths and also calculate the Joint losses. [7]
   b) A single-mode fiber has the following parameters:
   Normalized frequency (v) = 2.40, Core refractive index (n1) =1.46
   Core diameter (2a) =8 μm, Numerical aperture (NA) =0.1
   Estimate the total insertion loss of a fiber joint with a lateral misalignment of 1 μm and an angular misalignment of 1^0. [7]

5. a) Explain the working principle of avalanche photodiode with a neat diagram. [7]
   b) In a 100-ns pulse, 6x 10^6 photons at a wavelength of 1300nm fall on an InGaAs Photo detector on the average 5.4 x 10^6 electron-hole (e-h) pairs are generated. Find the quantum efficiency. [7]

6. a) Explain output pattern of surface in power launching from source to fiber. [7]
   b) Discuss the digital receiver performance. [7]

7. a) Estimate link power budget in optical communication system. [7]
   b) Discuss, how can we represent digital data in RZ code [7]

Code No: **R1641044** **R16** **Set No. 2**

IV B.Tech I Semester Regular Examinations, October/November - 2019

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

PART–A *(14 Marks)*

1. a) Distinguish the step index fibers & graded index fibers. [2]
   b) Explain the micro and macro bending. [3]
   c) Write short notes on single mode fiber connectors. [2]
   d) Discuss about the temperature effect on Avalanche gain. [2]
   e) What is equilibrium numerical aperture? [3]
   f) Write short notes on Eye patterns. [2]

PART–B *(4x14 = 56 Marks)*

2. a) What are the major problems encountered in the early development of optical communication for the practical use? Explain. [7]
   b) Discuss the total internal reflection in OFC using Snell's law. [7]

3. a) Explain the material dispersion in optical wave guides. [7]
   b) Glass fiber exhibits material dispersion given by $\lambda^2(d^2$ n1/d $\lambda 2)$ of 025. Determine material dispersion parameter at a wavelength of 0.85μm and estimate rms pulse broadening/km for good LED source with an rms spectral width of 20 nm at this wavelength. [7]

4. a) Discuss about multimode fiber joints. [7]
   b) Explain different splicing techniques [7]

5. a) Explain briefly about LED structures. [7]
   b) The quantum efficiency of an InGaAs PIN diode is 80% in the wave length range between 1300nm and 1600nm. Compute the range of responsivity of the PIN diode in the specified wavelength range. [7]

6. a) Derive the equation of power coupled into step indexed optical fiber from the LED as source. [7]
   b) Explain the fundamentals of digital signal transmission. [7]

7. a) Discuss system considerations in point to point optical link. [7]
   b) Compare the advantages and disadvantages of using WDM in an optical fiber communication system. [7]

Code No: **R1641044** **R16** **Set No. 3**

IV B.Tech I Semester Regular Examinations, October/November - 2019

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

PART–A *(14 Marks)*

1. a) What are skew rays? [2]
   b) What are different fiber materials used in optical communication? [2]
   c) Mention the optical fiber connector types. [2]
   d) Define responsivity and quantum efficiency. [3]
   e) Define diffusion length and carrier lifetime. [3]
   f) What is the necessity of WDM in optical communication system? [2]

PART–B *(4x14 = 56 Marks)*

2. a) Define numerical Aperture. How to calculate numerical aperture of a given fiber? Explain. [7]
   b) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine: (i) the critical angle at the core–cladding interface; (ii) the NA for the fiber; (iii) the acceptance angle in air for the fiber. [7]

3. Explain all four types of distortion mechanisms in optical communication. [14]

4. a) Write about fiber alignment & joint losses. [7]
   b) Explain the need of Expanded Beam Connectors (EBC) and working of EBC. [7]

5. a) Derive the laser diode rate equation. [9]
   b) Photons of energy 1.53 x 10^{-19} J are incident on a photodiode which has a responsivity of 0.65 A/W. If the optical power level is 10 μW, Find the Photocurrent generated. [5]

6. a) Explain optical receiver and its configuration with a neat sketch. [7]
   b) Write note on Probability of error and quantum limit in a optical receiver. [7]

7. a) Discuss in detail about the principle of WDM network with suitable diagram. [7]
   b) How the attenuation is measured using eye pattern? [7]

Code No: **R1641044** **R16** **Set No. 4**

IV B.Tech I Semester Regular Examinations, October/November - 2019

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
*****

PART–A *(14 Marks)*

1. a) Mention any six advantages of OFC. [2]
   b) Discuss the intra modal dispersion effect in optical fiber. [3]
   c) Mention the different splicing techniques. [2]
   d) Define cutoff wavelength of a pin photo detectors. [2]
   e) Differentiate between, 'Quantum limit' and 'Dark current'. [3]
   f) Discuss various line codes which are used in optical links. [2]

PART–B *(4x14 = 56 Marks)*

2. a) With a neat diagram, explain the working principle of analog and digital optical communication systems. [7]
   b) Write about mode coupling and V number. [7]

3. a) Explain Signal distortion in optical fibers due to attenuation and absorption. [7]
   b) Derive an expression for pulse spreading due to material dispersion which is a function of wavelength and time delay. [7]

4. a) Explain the fusion splicing technique in optical fiber with suitable diagrams. [7]
   b) Discuss about connector return loss. [7]

5. a) Compare different photo detectors. [7]
   b) A PIN diode is characterized by a quantum efficiency of 72% at a wavelength of 900 nm. Calculate: (i) Responsivity of the PIN diode at 900nm. (ii) Received optical power if the mean photo current is 10 mA at 900nm. (iii) Number of received photons for 1 mA mean photo generated current. [7]

6. a) Derive the relation between power launching and wave length. [7]
   b) Explain the working principle of analog receivers. [7]

7. a) Discuss about the point to point fiber optic link and its characteristics with an example. [7]
   b) Explain about the frequency chirping and its effects. [7]